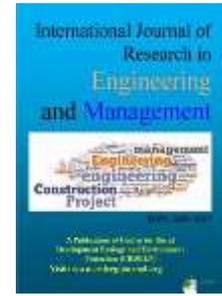


Vol. 5. No. 2. 2022

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Contents available at:
www.crdeepjournal.orgInternational Journal of Research in Engineering & Management (ISSN: 2456-1029) (SJIF: 2.228)
A Peer Reviewed JournalFull Length Research Paper**Factors Affecting the Productivity of Road Construction Projects in Egypt**Shrouk Awaad¹, Ibrahim Mahdi¹, Dina Mahmoud¹, Ibrahim Abdelrashid²,¹. Structural Engineering and Construction Management Department, Faculty of Engineering, Future University, Cairo, Egypt.². Structural Engineering Department, Ain Shams University, Egypt.**ARTICLE INFORMATION****ABSTRACT****Corresponding Author:**
Shrouk Awaad**Article history:**Received: 25-03-2022
Revised: - 02-04-2022
Accepted: 20-04-2022
Published: 25-04-2022**Key words:**Construction, road
construction, factors
affecting, productivity,
performance, Egypt.

Several road construction projects in Egypt and other countries are not completed within the estimated time and cost in addition to the various quality issues. Construction delays are a common phenomenon in Egypt's civil engineering projects, including road construction projects. The objective of this research is to identify the factors affecting road construction projects performance in Egypt. A detailed literature review and an interview with highway project managers is conducted to identify these factors. Where numerous challenges and complex issues in terms of performance and productivity, including cost, time, scope, and quality are facing road construction projects in Egypt. Other concerns include scope change, health and safety issues, functionality, and environmental anxiety. Findings have confirmed that poor project planning and poor implementation management have remained the most significant factors affecting road project performance.

Introduction and background

Productivity is a key function in all infrastructure development environments considering cost and time. In road construction industry, performance is a crucial component in evaluating how well a pavement will operate under traffic loading and when exposed to environmental effects. It also gives the owner and contractor a tool to ensure that the desired results are achieved in the production of high-quality and long-lasting pavements. In road construction projects, the ultimate goal for the owner is to develop a pavement that will have adequate serviceability under the local conditions and traffic circumstances that the pavement will be subjected to during its expected life, while also resulting in the lowest overall cost. Roads asphalt concrete pavement's performance is a function of the pavement quality which is affected by many interrelated factors such as the structural design of the pavement, the materials used in its construction, and the process by which these materials are incorporated into the pavement. Pavement deteriorates over time, and the rate of deterioration varies greatly depending on the factors mentioned and the amount of maintenance performed by the roads agency during the pavement's service life. However, proper construction quality will help to slow down the rate of deterioration as often as possible [1].

Productivity in road construction projects is one of the most important factors influencing the overall performance of any construction industry. Poor productivity of construction workers is one of the causes of time and cost overrun in road construction projects [2]. Thus, the aim of this paper was to use literature review and interviews with road construction experts to identify the factors influencing the performance of road construction projects in Egypt in order to contribute in the improvement of road construction project.

Literature Review

This section includes a review of relevant books, journals, abstracts, and case studies on the performance and productivity of roads construction projects.

Key Concepts of Project Performance

To measure project performance, a range of performance indicators should be considered, including time, cost, quality, client satisfaction, client changes, business performance, capability, profitability, health and safety [3]. According to Okuwoga (2014), the construction industry's performance is a cause of concern for both public and private sector clients. According to Aziz and Hafez (2013), project performance measurement entails improving the cost, schedule, and quality of the design and construction stages [4].

Problem of Performance in Construction Industry

According to Ogunlana et al. (2015), construction industry performance issues in developing economies can be divided into three categories: problems caused by shortages or inadequacies in industry infrastructure (primarily resource supply), problems caused by clients and consultants, and problems caused by contractor incompetence/ inadequacy [5], [6]. Okuwoga identified the performance issue as being related to poor budgetary and time management [7].

Factors Affecting Productivity

Factors that affect productivity could have a short-term or long-term impact on the project; some have a short-term impact but have a long-term ripple effect. Productivity is made up of various components such as labor, finance, and infrastructure, Plant and machinery, facilities, and so on. Various studies have been conducted in various countries to identify the factors influencing on-site productivity in construction projects. Researchers have used a variety of methodologies and approaches to develop different schemes for categorizing factors affecting productivity [8], [9]. The Business Council of Australia (BCA) published a report in June 2012 detailing how much more expensive it is to fabricate various forms of infrastructure in Australia than it is in the United States. The most pessimistic possibilities were cited as air terminals (90 percent extra cost) and doctor's facilities (62 percent extra cost), with diverse projects ranging from 26 to 43 percent extra cost. They used these numbers to conclude that Australia is a high-cost, low-productivity environment for infrastructure development. These scenarios were based on cost per square meter statistics provided by a well-known global construction consultant [10]. Doloi investigated the influence of low construction worker productivity on project costs and delays. And the data imply that the productivity of the workforce has a substantial impact on the cost and timeliness of any project [11].

Factors Affecting Cost and Time Performance

Several previous researches on project performance based on cost and time aspects have been conducted. A study discovered that the three most significant factors causing delays and problems with time performance in local building works are poor site management, unforeseen ground conditions, and slow decision making involving all project teams. As a result, the consequences of delays may include time and cost overruns, litigation, and project abandonment [12]. Cost overruns, according to Rajakumar, seem to be more common in infrastructure projects, especially road construction activities. Cost overruns have a far greater impact in developing countries than in developed countries. In fact, cost overruns affect 100 percent of projects in developing countries [13]. This research was carried out to identify the cost overrun causes in road construction projects in the West Bank of Palestine from the perspective of consultants. A questionnaire survey of 40 consultants was carried out. The survey included 51 suggested factors based on a review of the literature. The factors were ranked in order of importance as determined by the respondents. According to the findings, the top five influencing factors are: material price variance, inadequate time for estimate, contract experience, contract magnitude, and incomplete drawings [14].

Factors Affecting Road Construction Performance

Several papers have looked into the factors that influence road construction project performance in a variety of ways. Some of the studies identified the most relevant characteristics in a variety of nations and project types, while others examined the impact of these factors on the success and failure of construction projects and recommended solutions to improve and minimize their impact. According to a research published by Bitamba, the most important factors influencing construction project performance in Gaza were border and road closures, material shortages, unavailability of resources, a low level of project leadership skills, material price escalation, unavailability of highly experienced and qualified personnel, and poor quality of available equipment and raw materials [15]. Alinaitwe also observed that a number of factors influenced by clients can impact road construction performance, including design changes, stoppage due to contractor-owner disputes, stoppage due to insolvency, non-compliance with regulatory requirements, and inspection delays [16].

Research Methodology

There was an exploratory study with both qualitative and quantitative components, involving comprehensive research of backup data from previous studies. The research was conducted in Egypt and on road construction projects. Using a literature review and a qualitative data from individual interviews with highway project managers and experts of this study, the study sought to identify the factors influencing the performance of road construction projects. Thematic analysis is used to analyze the qualitative data. Through open-ended interviews with project managers, this study collects data on factors impacting highway projects. Individual interviews, as contrary to questionnaire surveys, allow investigators to clarify, understand

better, and discover respondents' opinions and experiences. Furthermore, open-ended questions encourage participants to provide as much detail as they want. This study targets population of project managers from highway construction certified companies who hold first, second or third grade license. The data for this study was collected by interviewing twelve valid respondents.

Findings and Discussion

According to the literature reviewed and the analyzation of the individual interview data with twelve project managers of highway projects in Egypt. Chart 1 summarizes the most important factors influencing road construction projects in Egypt. From the standpoint of a project manager, the elements are divided into internal and external factors in this study. In other words, internal factors include elements that project managers can usually control (for example, equipment shortages that can be alleviated by resource management methods). External influences, on the other hand, are often unmanageable by project managers (e.g., delays in progress payment by clients).

Variables connected to procedure, labor, material, and equipment are considered internal factors, whereas variables relating to the construction site and third parties are considered external factors. In the next subsections, these variables are further explained.

Internal Factors affecting road construction projects

Process-related internal factors

Workflows for the design process are included in this category. Several participants noted that projects lacking an effective design workflow are more likely to have incomplete, defective, or unfinished drawings, which can lead to deficient construction documentation for project implementation. Contractors and their project team members may be idling their work due to incomplete paperwork, the process of reviewing the documents, and challenges with project planning induced by these documents. Participants also believe that an efficient workflow is especially important to provide minimal disruptions in highway projects because designs change during the duration of the project. Furthermore, it is claimed that by implementing a good workflow, human errors in the design process can be minimized.

Labor-related internal factors

Competencies of project managers and workforce availability are two human-related internal elements in this study. Project managers' abilities, according to participants, play a critical role in assuring the success of road construction projects. Project managers, in particular, are expected to be able to deal with a wide range of challenges and problems on construction sites, manage large groups of workers, and plan and schedule projects. While the majority of these skills are associated with soft skills or people skills such as analytical and problem-solving, communication, collaboration, and planning and organizational [17], participants also suggested that project managers should have knowledge of highway construction in order to be effective. As a result, these findings show that project managers' abilities have an impact on the success of road construction projects.

Furthermore, it is claimed that having a sufficient workforce plays a critical role in project success. In general, Egyptian highway projects have reported labor shortages because local inhabitants are unwilling to engage in the construction business since it is filthy, dangerous, and difficult. While hiring foreign workers is a viable option, obtaining work permits from the government is more difficult due to certain restrictions.

As a result, obtaining the necessary personnel for highway construction is a challenge, particularly for large-scale projects requiring a big number of people. Participants also mentioned that, in addition to the labor shortage, highway projects are having trouble finding people with the necessary skills, expertise, talents and abilities for the job. This circumstance exacerbates the difficulty of assembling a qualified crew for highway improvements.

Material-related internal factors

The availability of materials during construction is one of the internal material-related issues. While materials should theoretically be available at any time during construction, highway projects are likely to face delays due to a variety of factors, including a lack of required materials in local markets, suppliers unable to provide materials due to material shortages, unreasonable pricing for monopolizing practices, and insufficient ground transportation to transport materials to the site. While projects can choose to obtain resources from overseas markets, this technique is thought to be more risky due to currency fluctuations.

Equipment-related internal factors

Like materials-related internal factors, concern the resource's (in this case, equipment and machinery) availability throughout construction. While some may believe that equipment faults are unavoidable, project managers may avoid depreciation by assuring correct functioning, doing enough preventive maintenance, and constantly monitoring equipment [18]. In addition to

equipment failures, there are projects with insufficient equipment or machinery. As a result, project managers should ensure that a competent equipment management system is in place to ensure that highway projects succeed.

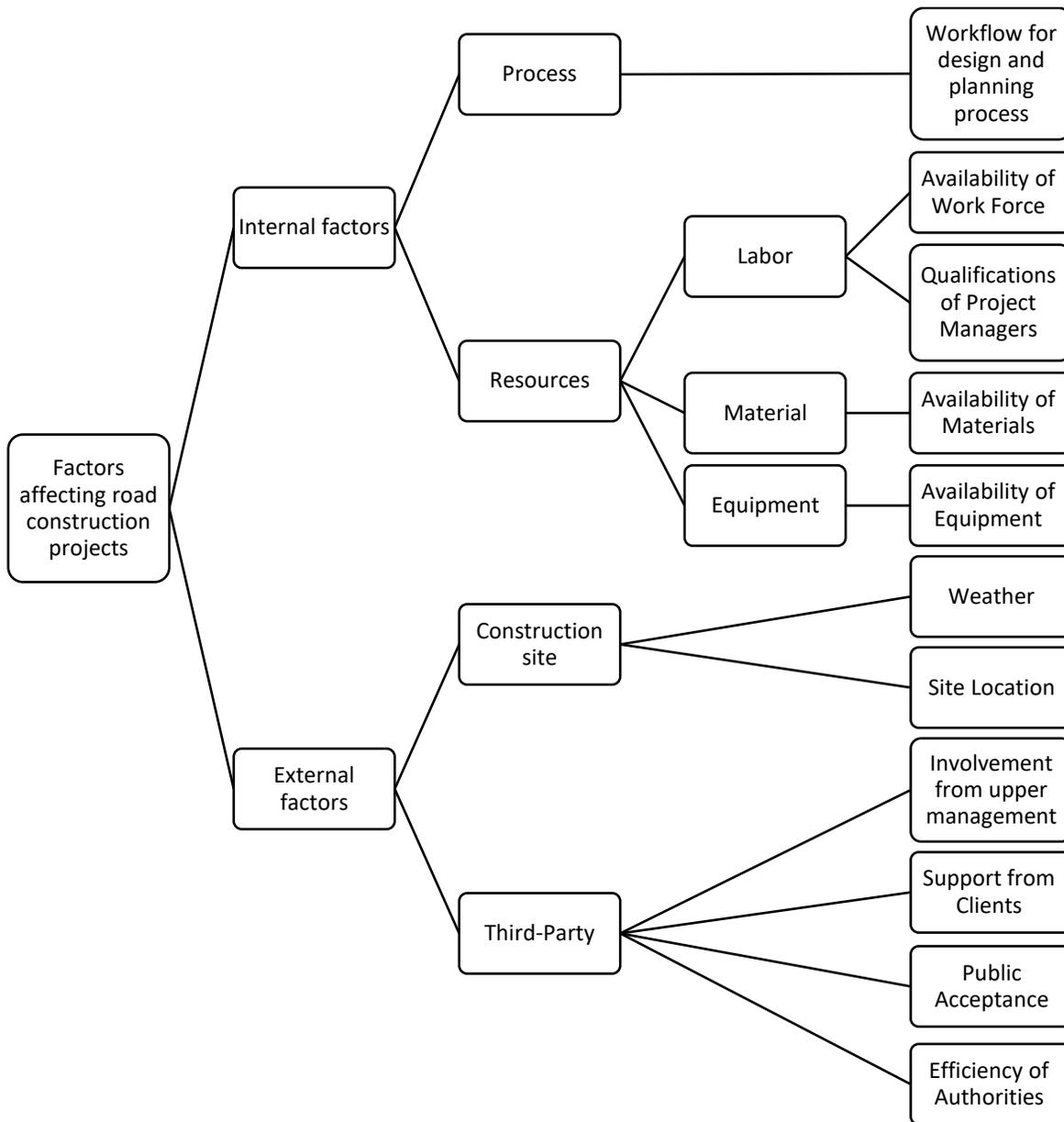


Chart 1. Factors affecting the success of road construction projects in Egypt

External Factors affecting road construction Projects

Construction-site related external factors

Weather and site location are two factors that affect the performance of road construction projects in Egypt, according to a review of literature and a review of individual interviews with project managers. First, in addition to reducing and delaying the workforce's ability to work, rain has a greater impact on road construction projects than on building projects, because highway projects are more susceptible to rainfall. As a result, weather has an important effect in the success of road projects, as evidenced by previous research, such as the study on the causes of project delays in Kang valley [19]. The next point raised by respondents is that the location of a construction site can have a significant impact on how quickly a roadway project is completed. For example, highway projects including difficult-to-build terrains, such as steep or rocky terrains, are more demanding during earthmoving and drainage concerns than those involving more typical terrains. Forested or swampy terrains are also less accessible. Furthermore, roadways that span rivers or lakes are difficult to build since they require bridges. While these issues are more commonly connected with highway projects in rural regions, construction sites in cities also face obstacles, such as obtaining licenses from authorities, controlling traffic, transferring subsurface utilities and

services, and setting up storage places. In addition, whether a project is in an urban or rural setting, the distance between sites and the nearest quarry might have an impact on its performance due to issues of accessibility and cost. In other words, in addition to the issues that arise from various site conditions as a result of poor site assessment [20], site location can have a variety of effects on highway projects.

Third party-related external factors

The success of highway projects is strongly influenced by third parties such as higher management, clients, the public, and authorities. Top management can impact project performance by ensuring that projects are funded in advance of progress payments (i.e., financial support) and visiting project locations to provide feedback and encouragement to workforce (i.e., emotional support). Management may also help projects succeed by ensuring that they have an enough number of workers with the necessary skills. One way to accomplish this is for responsible parties to identify gaps in the skills of those who will be involved in the project. On the other hand, clients are a third-party that is indirectly involved in the projects and can help by paying progress payments on schedule and providing constructive comments to project team members to reduce unneeded stress. Third-parties who are indirectly involved in highway projects, such as the public, can have an impact on these projects by causing issues arising from differing political viewpoints, unstructured compensation and disputes during the land acquisition process, and complaints to the authorities due to traffic congestion. These issues may cause projects to delay until the issues are handled. While there have been public complaints, numerous participants have suggested that highway projects may require the construction of alternative roads and operating at night due to traffic issues, safety concerns, and public perception. Furthermore, authorities, as well as other third-parties that are indirectly associated with highway projects, are said to have an impact on the project's performance due to the processing timeframes of submittals by authorities. Highway projects may face challenges such as stalling and wasteful rescheduling due to unpredictable and slower-than-normal processing timeframes. To put it another way, public approval and efficient government agencies are also variables that influence the success of highway projects.

Conclusion

This study reviews a detailed literature and analysis of interview data with twelve highway project managers to identify factors that affect road construction project success in Egypt, in order to promote the success of road construction projects in Egypt. The results of the thematic analysis revealed 11 factors that influence the success of road development projects in Egypt.

The factors are as follows: workflow for the planning process, project manager competencies, workforce availability, materials availability, equipment availability, weather, site location, participation from upper management, client support, public acceptance, and authority efficiency. These factors are classified into six categories: process, labor, material, construction site, equipment and third-party. These categories can then be divided into two groups: internal factors and external factors.

These findings highlight the importance of identifying opportunities to avoid factors that can adversely impact project success, particularly internal factors which proved that poor project planning and poor implementation management have remained the most significant factors affecting road project performance. This research makes a significant theoretical and practical contribution by providing researchers and practitioners with a set of alternative factors influencing road construction project success.

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